Optimized Cooling vs Accelerator Acceptance

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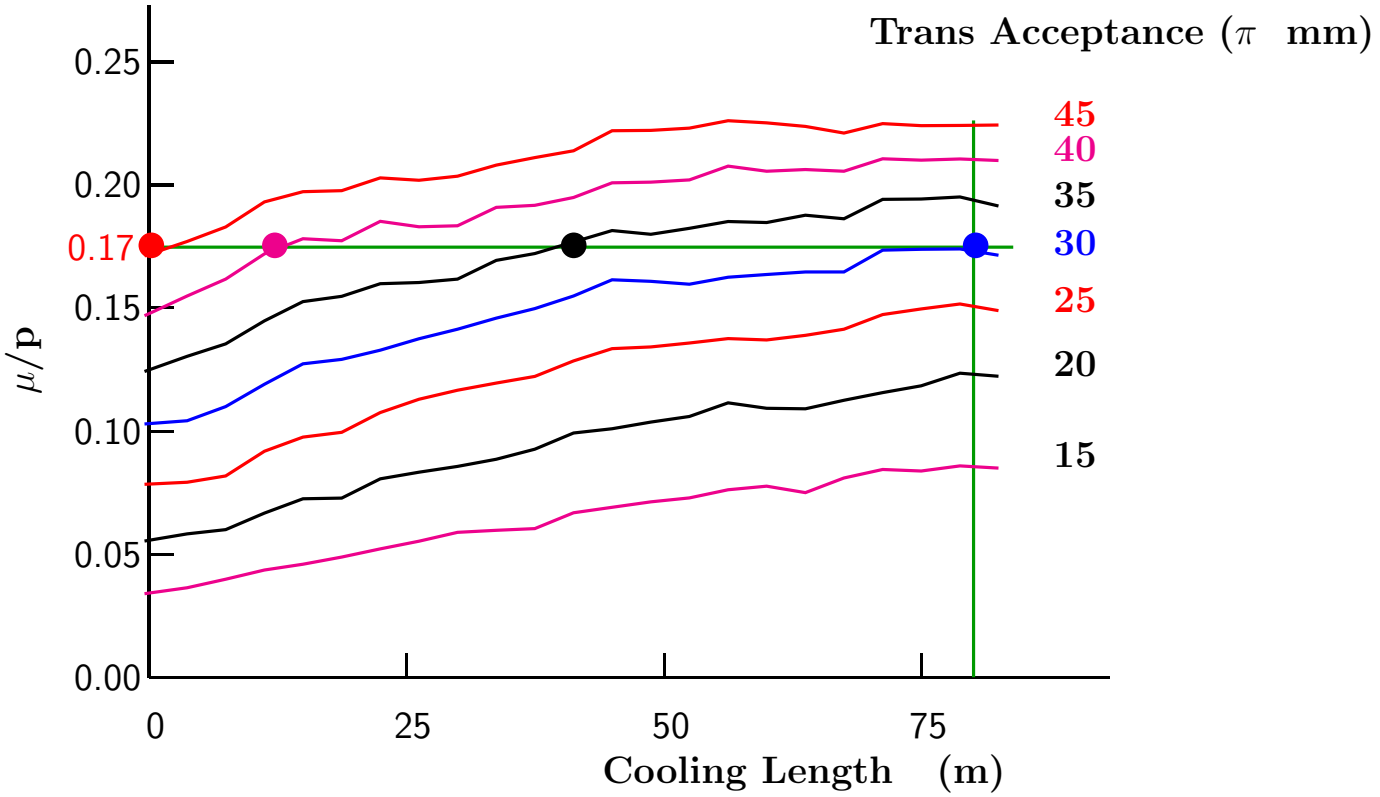
1. Optimized Cooling for Factory
2. Design of lattice for start of Linac

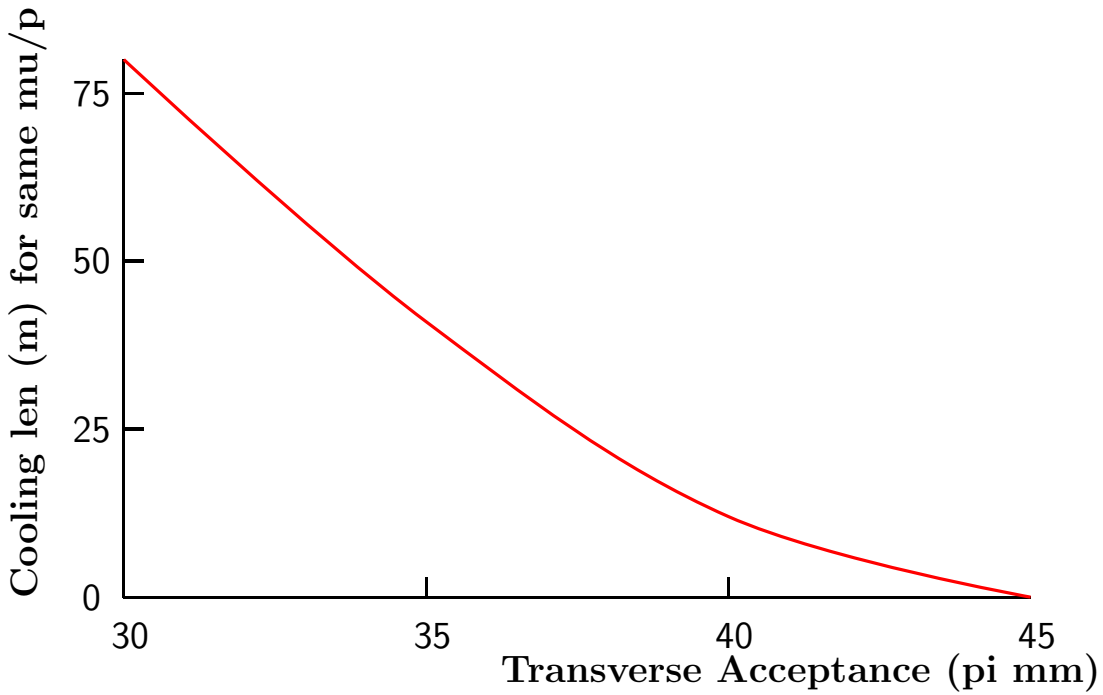
• Cooling vs Accelerator Acceptance

- Using US Study 2a (APS Neutrino Matrix) as example
- Use ICOOL for performance simulation

Muons per proton for different Cooling length and acceleration apertures



• Cooling needed for same 0.17 Muons per proton vs Acceleration aperture

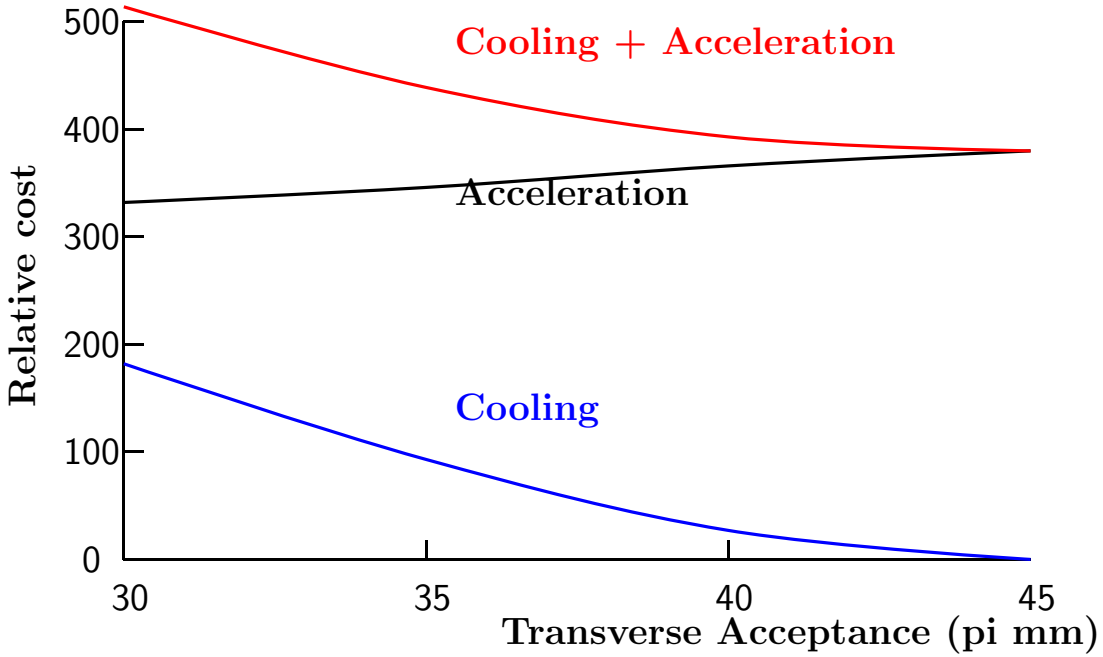


• Estimating Costs

- Hard
- Mostly scale from study 2
- Needs much more work

• (Acc + Cooling) Costs for same μ/p vs. acceptances

- Accelerator costs for two FFAG's from Berg
- Linac and RLA costs scaled from relative FFAG costs



- Minimum cost appears to be with NO cooling
- Not known if lower energy $>$ 30 pi mm accelerations are practical
- Certainly their costs are not really known
- But the case for cooling is not obvious

Other advantages of using no cooling

- Less R&D Required we have little time before Alain's "window"
- No field "flips"
- Reduced Requirement on capture acceptance
  - Smaller aperture phase rotation RF
  - Smaller or lower field focusing in drift
  - Lower Capture Field
- Less dependent on use of RF in magnetic fields

The savings could be more than suggested above

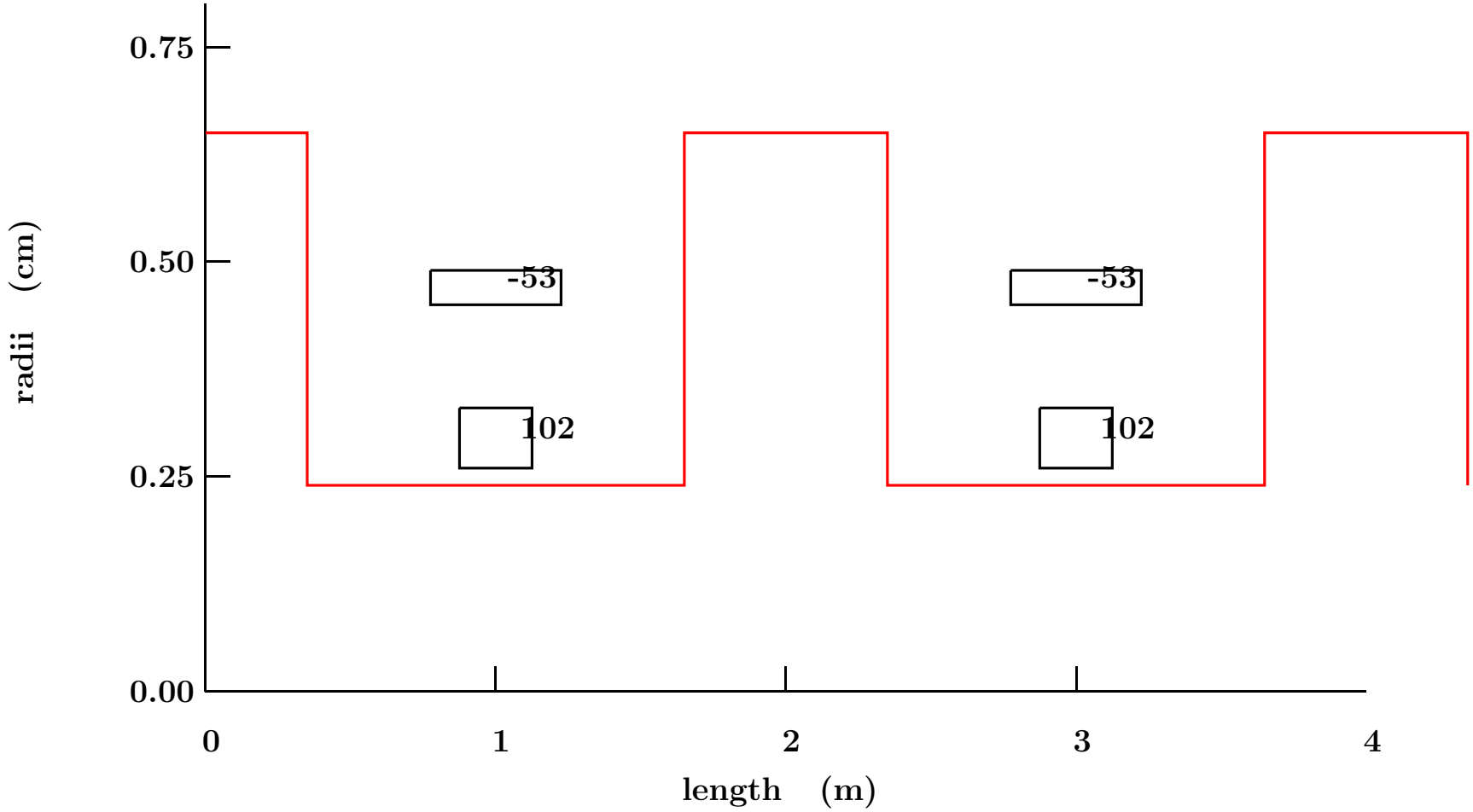
Design of Lattice for Start of Linac

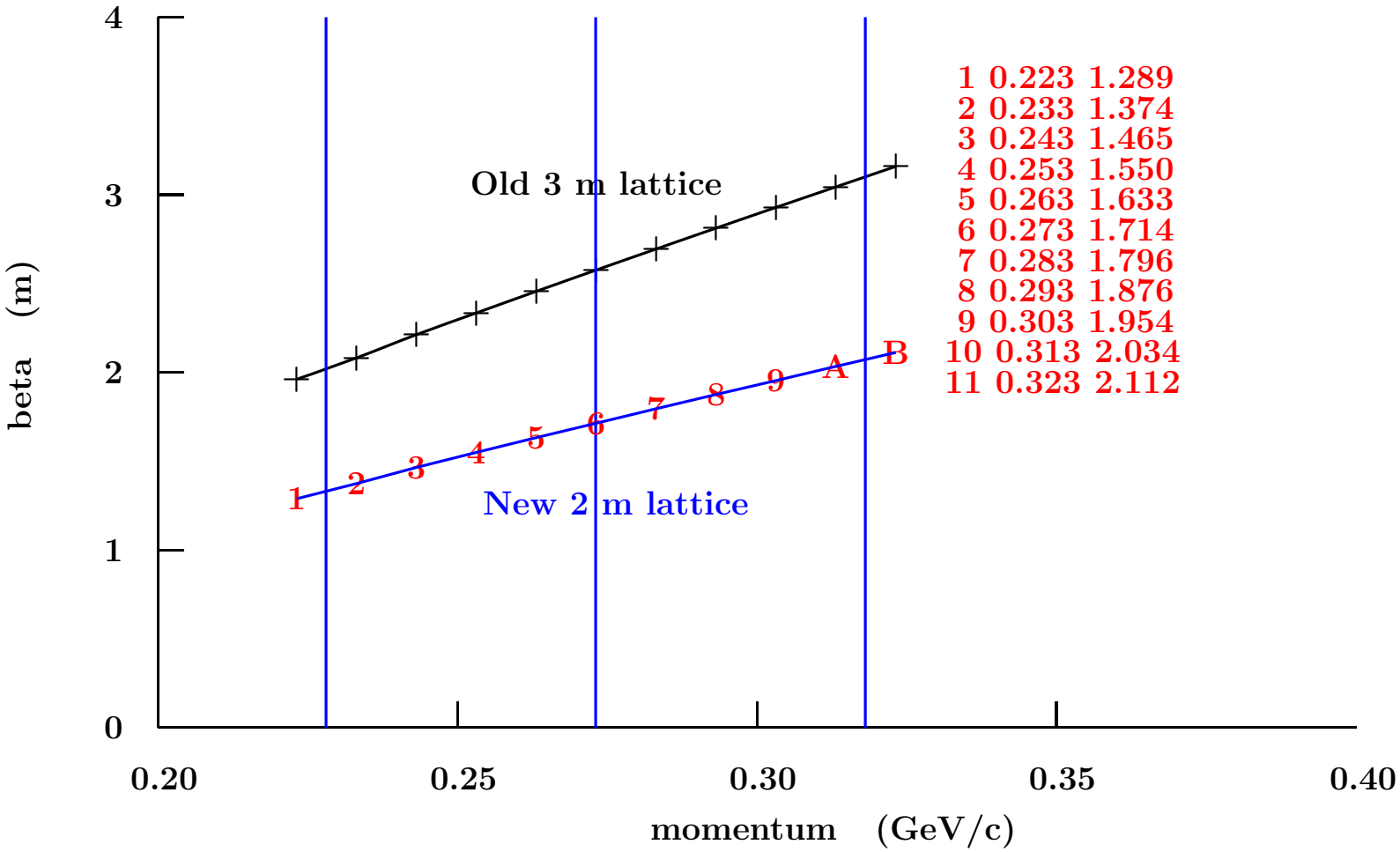
- This may be the hardest place to increase acceptance 30 $\longrightarrow$ 45 pi mm
- Current Lattice has 3 m cells
- With 1 m long 1.2 T solenoids
- designed to have few Gauss fields on cavity

Try:

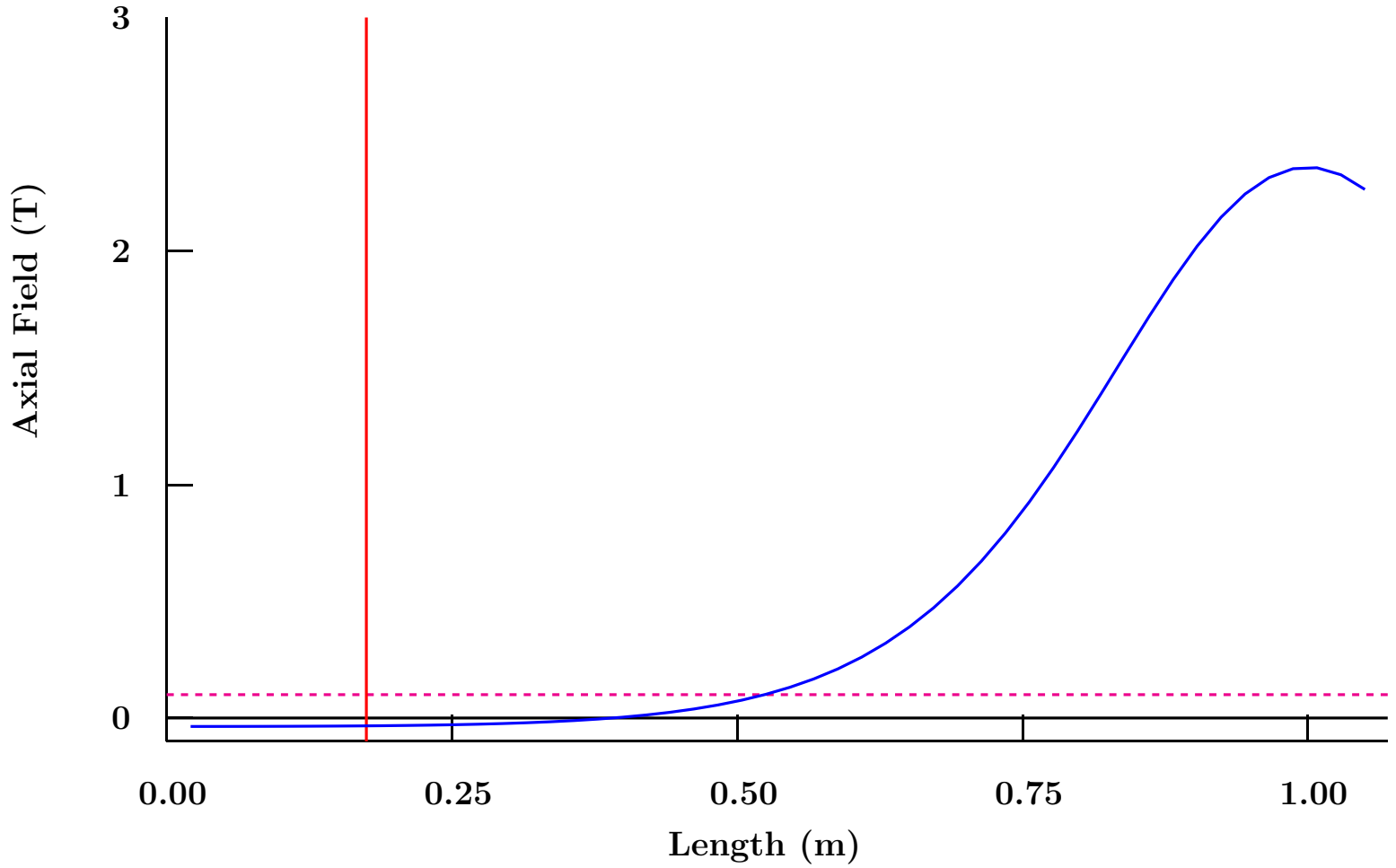
- Keep same phase advance per cell
- Reduce cell length by 30/45 to 2 m
  then all betas down by same factor
  and radii as before, but with the larger acceptance

- Require field on cavities only less than 0.1 T
- Do not use iron for first try

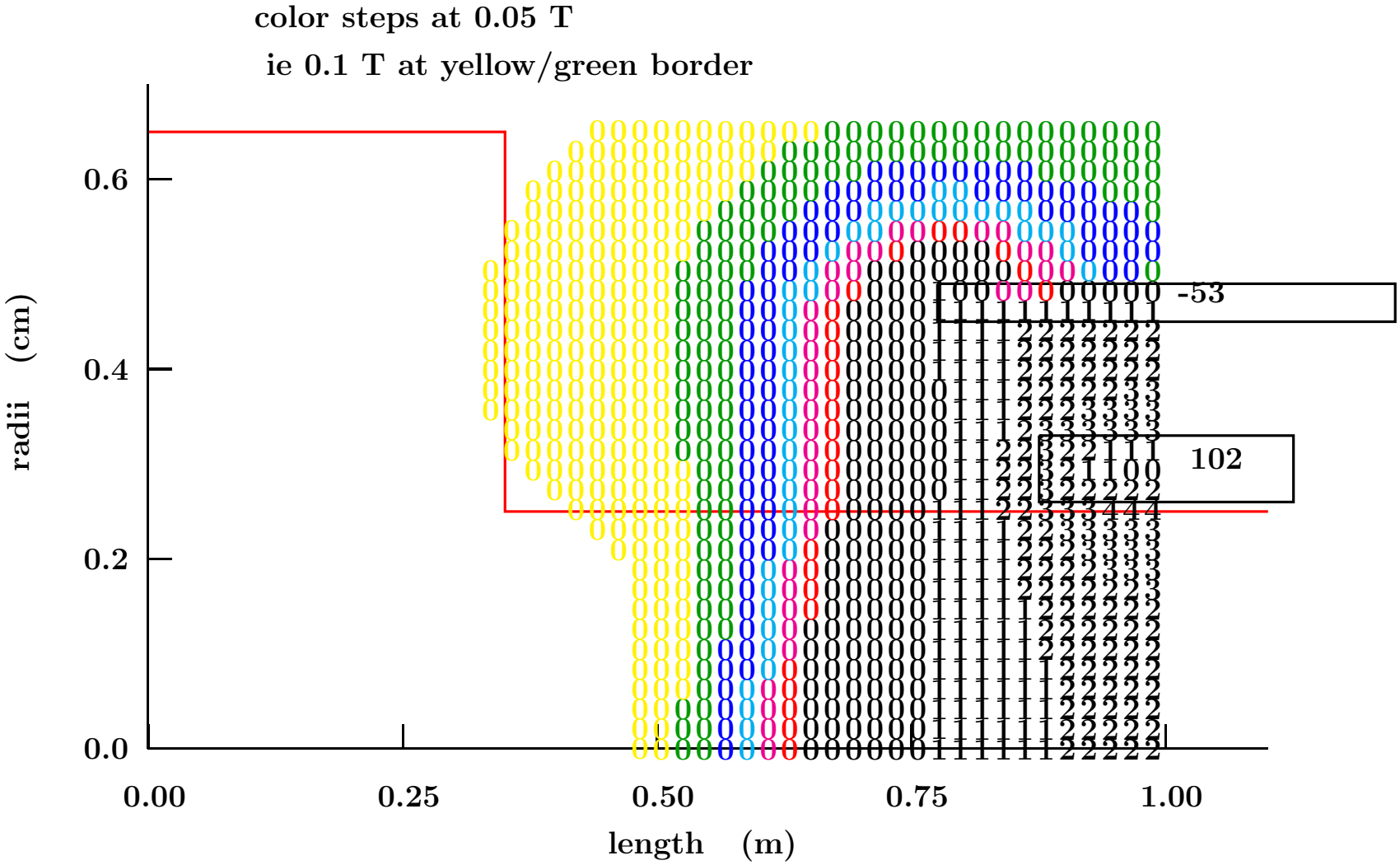

0.75
0.50
0.25
0.00
radii (cm)
-53
-53
102
102
0
1
2
3
4
length (m)



- Betas are down by 2/3
- Length down by 2/3
- Same phase advance



- Axial field only about twice 3m lattice
- Axial field less than 0.1 T at cavity
- But what are fields off axis?



- Fields are less than 0.1 T on cavity walls at all radii
- And this is only a first try

Comments

- The shorter cells will give higher average acceleration
- And will have larger longitudinal acceptance
- And they may not cost much more

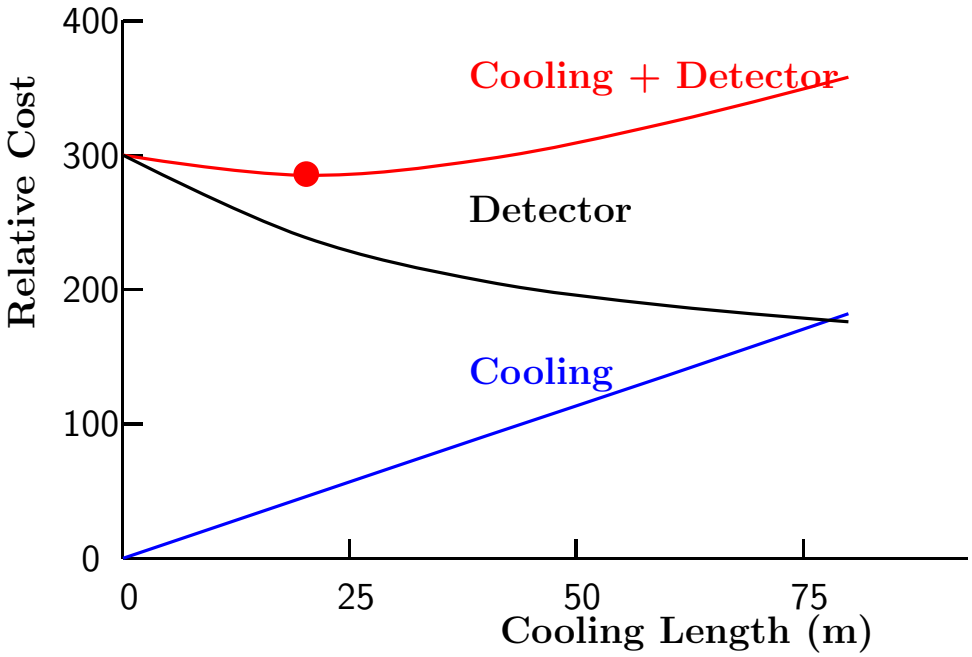
- **It is looking good**

  But need more work

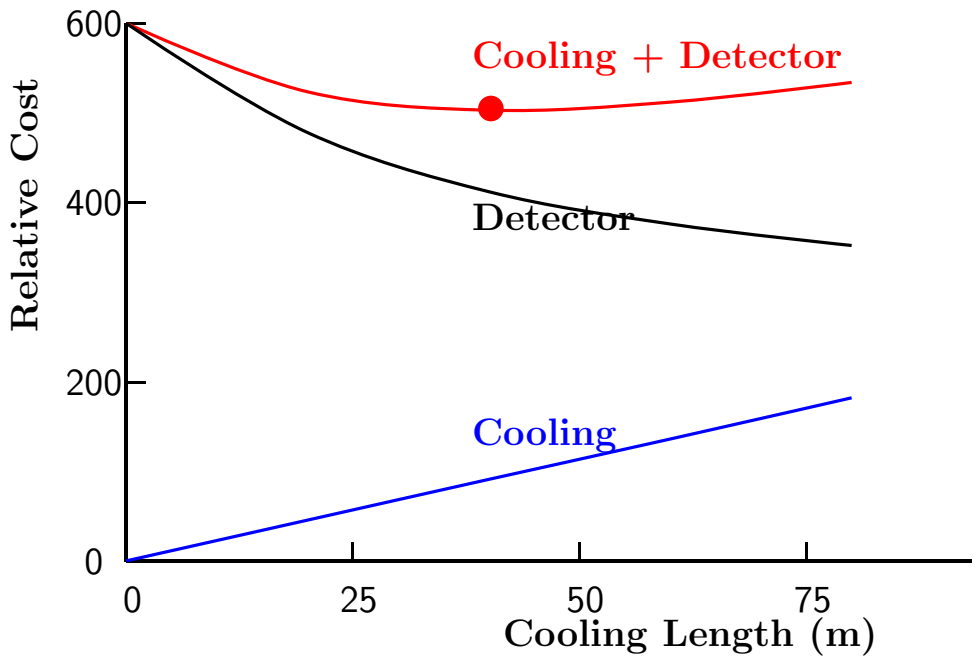
• Cooling vs Detector Size

- Pick base detector cost in very approximate unloaded M$
- Scale detector size (and cost) to achieve same number of events with different cooling lengths

For 300 M$ base detector cost



For 500M$ Detector



≈ 300 M$ Detector (Blondel)

≈ 500 M$ Detector (Berg)

- Resulting minimum depends on chosen detector cost
- But minima are with relatively little cooling